Tractors

March, 1961

REPORT NO. 121

UNIVERSITY OF BRISTOL

Department of Economics (Agricultural Economics)
Bristol II. Province

TRACTOR OPERATING COSTS ON A SAMPLE OF FARMS IN SOUTH WEST ENGLAND 1959

Price Three Shillings and Sixpence

I, COURTENAY PARK,
NEWTON ABBOT,
DEVON.

U N I V E R S I T Y O F B R I S T O L

Department of Economics
(Agricultural Economics)

TRACTOR OPERATING COSTS ON A SAMPLE OF FARMS IN SOUTH WEST ENGLAND

1959

ACKNOWLEDGEMENTS

The Department of Economics (Agricultural Economics) of the University of Bristol at Newton Abbot gratefully acknowledges the willing co-operation of all those farmers who supplied the information, without which, the publication of this report would not have been possible.

The field work for this investigation was undertaken by Miss M. Loadman who also assisted in the analysis of the data. The preparation of the report was the responsibility of J. Brewer under the general direction of R. C. Rickard.

S. T. MORRIS

Provincial Agricultural Economist

CONTENTS

I. INTRODUCTION

This is the fourth in the series of tractor reports produced in this Department dealing with the operating costs of tractors in the South West.

Table 1 Tractor and Implement Numbers in England and Wales

	1942	1944	1946	1948	1950	1952	1954	1956	1958	1959
					000's					
Tractors:										
Wheeled	90	134	153	193	245	267	313	347	362	354
Tracklayers	5	8	9	11	13	15	20	15	17	16
Implements:										
Tractor ploughs	97	134	155	214	263	277	284	287	289	280
Cultivators & grubbers	44	67	83	100	139	148	167	n.a.	n.a.	n.a.
Tractor trailers	n.a.	n.a.	78	146	221	263	299	327	328	340
Corn drills	84	87	89	89	91	89	88	84	119	78
Combined drills	7	11	16	19	23	28	33	42		64
Fert. distributors	46	54	65	74	88	96	102	117	118	n.a.
Tractor mowers	21	36	48	66	107	133	152	191	186	195
Siderakes, tedders, swathturners & rakes	314	313	342	346	355	359	357	294	267	267
Binders	101	114	119	119	120	117	114	107	99	83

Source:- Agricultural Statistics and the Agricultural Machinery Censuses

Until 1954, the Agricultural Machinery Censuses had never broken down the numbers of tractors beyond the simple division into wheeled or tracklaying tractors. In 1954 a further classification was made on the basis of the fuel used - these data being given in a later table. The Censuses then reverted to the original classification for 1956 and 1957 - but in 1958 the fuel type classification was re-introduced for a year. For this reason the only figures available on a national scale for tractors classified by fuel type relate to 1954 and 1958. In 1957 the national figures were not broken down on a county basis but this has since been resumed.

From Table 1, which shows national figures, it can be seen that tractor numbers have increased by about three and a half times during the period covered by the table. In earlier years some horse-drawn equipment is also included and during the period covered by the comparison any increase in horse-drawn implements is negligible - in fact a very marked decrease has been evident where figures are available. From this, we can safely say that the increase in implements is almost entirely in tractor-drawn implements, many being new additions to farm machinery and some being replacements for obsolete horse-drawn equipment.

Table 2 Tractors in England and Wales and South West Province 1939 - 1959*

Year	England and Wales	Cornwall	Devon	Dorset	S.W. Province
	(000's)		Numbers		
1939	47	893	1320	855	3068
1950	259	6229	10709	4060	20998
1952	283	6925	12260	4476	23661
1954	334	8400	14284	5233	27917
1956	364	9145	15480	5795	30420
1958	379	9650	16670	5835	32155
1959	371	10015	16815	5930	32760
			Indices (1952=100)		
1939	17	13	11	19	13
1950	92	90	87	91	89
1952	100	100	100	100	100
1954	118	121	117	117	118
1956	129	132	126	129	129
1958	134	139	136	130	136
1959	131	145	137	132	138

Source: Agricultural Machinery Censuses

* The 1939 Census refers to wheeled tractors for field and stationery work and tracklaying tractors. The figures given for 1950 include wheeled and tracklaying tractors of 6 h.p. and over, while those for 1952 to date refer to both kinds of tractors of 10 h.p. and over.

A closer examination of the tables will reveal that the rate of increase in both tractor and implement numbers has slowed down since 1956. This is compatible with the view that British agriculture since about 1956 has been going through a phase of consolidation - following on the post war periods of recovery and rapid expansion.

From Table 2, it can be seen that in England and Wales the number of tractors has decreased between 1958 and 1959. In the South West Province, which comprises Cornwall, Devon and Dorset, the overall number of tractors continues to increase.

As far as types of tractor are concerned significant changes have also occurred as Table 3 shows. It can be seen that there has been a noticeable decline in the numbers of crawler or tracklaying tractors in 1958 as compared with 1954. This is represented by a fall in numbers from 20,593 in 1954 to 17,140 in 1958 - a fall of 17% on the 1954 total.

This decline in the popularity of tracklaying tractors may be related to the development of more powerful and heavier wheeled tractors which are able to work under conditions for which, previously, smaller tractors had been unsuitable and for which crawlers had been used. A contributory factor may also be additional initial capital expenditure involved with tracklayers and higher running costs. The depreciation charge is also correspondingly high.

In both wheeled and tracklaying tractors, the trend towards diesel fuel in preference to petrol and/or V.O. continues - and in the four year period covered by the comparison the change is very marked. Among wheeled tractors there was an increase of nearly 300% in the number of diesel-fuelled tractors and among tracklayers an increase of 22% was found. This corresponds with a decrease of 24% and 60% respectively in V.O.-fuelled wheeled and tracklaying tractors. The number of petrol only tractors has fallen substantially.

The comparison contained in the table is limited to 1954 and 1958, these being the only two years for which the Agricultural Machinery Censuses has broken down tractor numbers into wheeled and tracklayers and further, by fuel type.

From the analyses contained in this report, certain current trends are quite clear. It has been evident for some years past that the diesel-fuelled tractor has been gaining popularity over the V.O. tractor, a trend which has continued to the extent that the diesel now dominates the field.

Table 3 Comparison of Numbers and Types of Tractors 10 h.p. & over England and Wales

	1954	1958	Percent. of Total		Percentage Change 1954-1958
			1954	1958	
	No.	No.	%	%	%
Wheeled (inc. halftrack)					
V.O.	248,938	188,430	79	52	- 24
Petrol	26,515	17,555	9	5	- 34
Diesel	38,335	152,030	12	42	+ 297
	313,788	358,015	100	99	-
Other*	-	4,205	-	1	-
TOTAL	313,788	362,220	100	100	+ 15
Tracklayers					
V.O.	9,799	3,880	48	23	- 60
Petrol	2,461	1,475	12	8	- 40
Diesel	8,333	10,740	40	63	+ 22
	20,593	16,095	100	94	-
Other*	-	1,045	-	6	-
TOTAL	20,593	17,140	100	100	- 17

* Represents tractors not classified according to fuel type

Source: Agricultural Machinery Censuses

There are a number of factors which influence a farmer's choice of tractor - but perhaps the most important single factor is the nature of the work on the farm and the relative advantages of V.O. or diesel fuel for this type of work.

With diesel fuel there is no switch over from petrol as is the

case with V.O. - starting thus becomes a much simpler operation. Often, with V.O. tractors engaged on intermittent work the tractor is left running in between jobs to economise on the petrol used for starting. This does not arise in the case of diesel tractors. In addition, fuel consumption is lower in the case of diesel tractors and the fuel itself is cheaper. On the other hand, V.O. tractors run more cheaply when used for long periods, than they do when the work involves much stopping and starting.

From the sample costed in this investigation it would appear that diesel tractors are used more for field work than are V.O. tractors and V.O. tractors are used more for haulage. The distribution of field and haulage work between the V.O. and diesel tractors was as follows:-

	Percent. of all work done	
	V.O.	Diesel
	%	%
Field work	57.2	68.0
Haulage	41.3	28.2

This tendency may not be entirely due to the suitability of the tractor for field or haulage work, but may in part be due to the farmer's inclination to use the newer tractor for field work and the older tractor for haulage and odd jobs. This has limited application to this sample in which 25 farms had only one tractor.

There is no obvious reason why diesels should not continue to predominate and perhaps come to represent an even higher proportion of all tractors in use.

In this connection it is interesting to note that in the 1958 Agricultural Machinery Censuses there were still some 17,555 wheeled, and 1,475 tracklaying tractors of 10 h.p. and over, which were fuelled by petrol only. This is a total of 19,030 petrol tractors which represents a mere 5% of the total of 379,360 tractors in use.

II. RESULTS OF THE 1959 INVESTIGATION

(i) Source and Nature of the Information

The data on which this survey is based were collected during the year February 1st, 1959 to January 31st, 1960.

Thirty-six farms were included in the sample which contained 52 tractors. Individual records were kept by each farmer for each tractor and the results of the individual costings were used for the analysis.

Table 4 Data Relating to Sample Farms

	Devon and Cornwall	Dorset	All Farms
Number of farms	33	3	36
Number of tractors	41	11	52
Number of tractors costed	41	11	52
Per Farm:		acres	
Cereals	19·8	183·1	33·4
Roots	5·6	3·6	5·4
Green crops*	4·8	27·1	6·6
Temp. grass	39·4	206·1	53·2
Perm. grass+	52·9	119·9	58·5
Total	122·5	539·8	157·1

* Green crops includes cabbage, kale, broccoli, etc.
\+ Permanent grass includes rough grazings.

Within the 36 sample farms, situated in Cornwall, Devon and Dorset, there was a wide range of farm size - from a 43 acre farm in Devon with one tractor to an 846 acre farm in Dorset with a complement of six tractors.

The overall average size of the sample farms was 157·1 acres of crops and grass. This includes rough grazings on which tractors do little work.

Of the 36 farms in the sample, there were:-

25 farms with 1 tractor
9 farms with 2 tractors
1 farm with 3 tractors
1 farm with 6 tractors

The sample contained 52 tractors and for the purposes of this report they were classified according to the type of fuel used, viz: vaporising oil and diesel oil. There were no petrol fuelled tractors in the sample.

(ii) Type and Make of Tractors Costed

Among the tractors in the sample were two Fordson Diesel Crawlers - both in Dorset, and one steel-wheeled tractor operating in Devon.

Table 5 Type and Make of Tractors

	V.O.	Diesel	Total
David Brown 900	-	3	3
David Brown Cropmaster	3	1	4
David Brown 250	-	1	1
David Brown	1	-	1
Ferguson T.35	-	11	11
Ferguson T.20	2	1	3
Ferguson Standard	2	2	4
Ferguson R.O.D. 195	2	-	2
Fordson Standard	1	-	1
Fordson Standard (Steel Wheels)	1	-	1
Fordson Major	5	7	12
Fordson County Crawler	-	2	2
Nuffield Universal	-	4	4
International B.275	-	1	1
International B.W.O.6	-	1	1
International B.250	-	1	1
Total	17	35	52

Table 6 Tractors Classified by Fuel Used

	V.O.	Diesel
Devon and Cornwall	17	24
Dorset	-	11
Total	17	35

(iii) Relationship Between Numbers of Tractors and Total Livestock Units on Farms in the Sample

Total livestock units on farms	3413.8
Number of tractors on farms	52.0
Average livestock units per tractor	65.6

Table 7 Number of Tractors Related to Livestock Units

Livestock Units per Farm	No. of Farms	No. of farms with:-			
		1 tractor	2 tractors	3 tractors	6 tractors
0 - 63	11	10	1	-	-
64 - 125	18	11	6	1	-
126 and over	7	4	2	-	1
Total	36	25	9	1	1

Table 8 Average Livestock Units per Tractor

No. of Tractors on Farm	No. of Farms	Average Livestock Units per Tractor	Range in Livestock Units per Tractor
1	25	82.4	17.4 - 167.9
2	9	50.4	20.0 - 100.3
3	1	26.0	-
6	1	60.8	-

Table 9 Average Acres per Tractor

	Devon & Cornwall	Dorset
Total acreage	4042.5	1619.4
Average per tractor	98.5	147.2

It would be unwise on the evidence of these data, to attempt to draw any conclusions regarding the factors which govern the tractor power on farms.

Size of farm will obviously be an important factor but tractor power will also depend on the intensity of the farming system used. The numbers of stock are not an infallible guide - a more important factor would be the types of stock kept. The proportion of tillage and grassland acres will also be an important feature.

In a sample such as this - which includes many different farming systems, no meaningful result would be expected from a consideration of livestock units only.

(iv) Average Number of Hours Worked per Tractor

An average of the hours worked for the whole sample showed that the tractors worked an average of 682 hours each year, V.O. tractors averaging 492 hours and diesel tractors 774 hours.

The following table relates the tillage acres per tractor and distribution of the number of farms and hours worked.

Table 10 Tillage Acres & Distribution of Farms & Hours Worked

Acres per Tractor	Tractors in each group	No. of farms	Av. No. of Hours Worked per Tractor
0 - 49	7	4	564.8
50 - 69	7	7	491.0
70 - 99	11	8	541.8
100 - 149	18	9	762.5
150 - 199	3	3	849.8
200 - 249	5	4	630.0
250 and over	1	1	1468.0
-	52	36	-

(v) Age of Tractors

In connection with the age of tractors, it must be noted that apart from new tractors, age refers only to the period of time for which the tractor has been on the farm. The actual age of some of the second-hand tractors included in the sample will, therefore, be greater than the figure used in the analysis.

The average age of all tractors in the sample was found to be 3·4 years. The average age of all the V.O. tractors was 5·4 years compared with an average of 2·5 years among the diesel tractors in the sample.

Table 11 Age Distribution of Tractors - Diesel and V.O. New and Second-hand

	V.O.			Diesel			All Tractors		
	New	S.H.	All	New	S.H.	All	New	S.H.	All
Under 1 year	-	2	2	11	2	13	11	4	15
1 year & under 2 years	-	1	1	8	1	9	8	2	10
2 years " 3 "	1	1	2	5	1	6	6	2	8
3 " " 4 "	-	3	3	2	1	3	2	4	6
4 " " 5 "	1	1	2	1	-	1	2	1	3
5 " " 6 "	-	1	1	1	-	1	1	1	2
6 " " 7 "	1	-	1	2	-	2	3	-	3
7 " " 8 "	1	-	1	-	-	-	1	-	1
8 " " 9 "	2	1	3	-	-	-	2	1	3
9 years and over	1	-	1	-	-	-	1	-	1
Total	7	10	17	30	5	35	37	15	52

It will be seen that on average, diesel tractors are only half the age of V.O. tractors. This is a reflection of their increasing popularity during the recent 8 - 10 years - a trend which has continued and resulted in a higher proportion of diesel models among the newer tractors.

Of all the tractors in the sample 37 were bought new - of these 30 were diesel and 7 were V.O.-fuelled. These purchases of new

tractors range over a period of some 10 years - but the predominance of diesel tractors is abundantly clear.

Among the tractors in the sample which were bought second-hand, only five were diesel-fuelled while 10 were V.O.-fuelled. In this context it may be noted that the diesel tractors are comparatively new and it is reasonable to expect that V.O.-fuelled tractors would still dominate the second-hand market - possibly the result of more farmers making the change from V.O. to diesel.

Of the new tractors which have been on the farm for one year or less all were diesel-fuelled and this amounted to 11 tractors. Of the new tractors which have been on the farm between one and two years, all eight were found to be diesel-fuelled. This further confirms the swing from V.O. to diesel which has been a characteristic of recent years.

This analysis of tractor age, particularly among newly purchased tractors, emphasises the change from V.O. to diesel fuel.

It must be remembered, however, that this analysis is based on a comparatively small sample, but the results may be taken as an indication of current national trends.

(vi) Seasonal Distribution of Tractor Work

From the following table, it will be seen that there are two periods in the year during which the bulk of the tractor work is done. The April-May-June period is the most busy when about 38% of the total hours worked are found. The period from October to January is less busy and includes about 20% of the total hours worked.

Seven tractors were excluded from this analysis because the operational breakdown of working hours was inadequate.

Table 12 Hours Worked per Month - In Day Equivalents and as Percentages

Month	Average No. of Hours Worked per Tractor	8 Hour Day Equivalents	Percentage of all Work
February, 1959	64.0	8.1	9.5
March	53.1	6.6	7.9
April	68.8	8.6	10.2
May	85.9	10.7	12.7
June	101.0	12.7	14.9
July	54.6	6.9	8.1
August	61.9	7.6	9.2
September	48.5	6.1	7.2
October	40.2	5.1	5.9
November	33.9	4.4	5.0
December	29.6	3.5	4.4
January, 1960	33.6	4.1	5.0
Total	675.1	84.4	100.0

(vii) Type of Work Done

Tractors - together with the wide variety of implements now available are able to undertake a large number of different tasks on the farms - and a breakdown of the number of hours spent on these operations follows. Broadly, tractor work may be split into three main categories field work, haulage and belt work.

Table 13 Type of Work Done

	V.O. Tractors		Diesel Tractors		All Tractors	
	hrs.	%	hrs	%	hrs.	%
Field	4138.3	57.2	15743.7	68.0	19882.0	65.4
Haulage	2992.0	41.3	6515.7	28.2	9507.7	31.3
Belt	115.0	1.5	873.6	3.8	988.6	3.3
Total	7245.3	100.0	23133.0	100.0	30378.3	100.0

Table 14 Further Analysis of Hours Worked

Nature of Work	Hours per Tractor	Percentage of all Work
	hours	%
Ploughing	100.6	14.9
Harrowing and rolling	83.1	12.3
Dragging and scuffling	48.1	7.1
Ridging	.7	.1
Hoeing	2.2	.3
Drilling seeds & fertilisers	45.9	6.8
Spreading F.Y.M.	11.1	1.7
Reaping and mowing	47.5	7.0
Raking and baling	47.5	7.0
Root lifting	7.9	1.2
Silage making	29.9	4.4
Hedging	17.0	2.5
Ditching	.3	.1
Total Field Work	441.8	65.4
General haulage	146.0	21.6
Hay and corn harvest	38.0	5.6
Roots and fodder	5.6	.9
Manure carting	21.7	3.2
Total Haulage	211.3	31.3
Belt work	22.0	3.3
TOTAL	675.1	100.0

Field work represents nearly two-thirds of all work done by tractors while haulage accounts for rather less than one-third of tractor hours.

The amount of belt work - such as grinding, threshing, stationary baling and wood sawing is a very small amount of all work done, viz: 3.3%.

(viii) Fuel Consumption per Hour - V.O. and Diesel

Among the 35 diesel-fuelled tractors in the sample the average hourly fuel consumption was found to be 0.63 gallons per hour. As can be seen from the following table there was an even range of variation from this mean.

Table 15 Fuel Consumption per Hour - Range Distribution

Fuel per Hour	V.O.	Diesel
	No.	No.
Under 0·4 gallon	1	2
0·4 & under 0·5 gallon	1	4
0·5 " 0·6 "	2	8
0·6 " 0·7 "	1	10
0·7 " 0·8 "	2	3
0·8 " 0·9 "	1	4
0·9 " 1·0 "	5	3
1·0 gallon and over	4	1
Total	17	35

For the 17 V.O.-fuelled tractors in the sample, the average hourly fuel consumption of V.O. was found to be 0·85 gallons per hour. From this mean there was a wider range of variation than was found among the diesel tractors.

From the data relative to this sample it is not possible to draw any valid indication of the effects of the type of work done on fuel consumption. Other factors such as the mechanical condition of the tractor and the skill of the operator will also have some influence on fuel consumption.

(ix) Average Operating Costs per Tractor and Per Hour Worked

The operating costs per hour of a tractor are made up mainly of the direct costs plus a depreciation charge. These direct costs include fuel, oil and grease, repairs, maintenance and servicing, insurance and tax.

For the purposes of this analysis, major additions to any tractor, such as cabs and power take-off units have been treated as items of capital expenditure. The cost has been added to the capital cost of the tractor and depreciated accordingly.

The rate of fuel consumption together with the cost of fuel, age of tractor and the hours worked are all factors which influence costs. Less tangible, but still of importance as an element of cost is the care in use and regular maintenance which the tractor should receive - rough handling and usage can add considerably to the direct running costs of a tractor. In the case of vaporising oil tractors, the cost of the petrol used for starting is included under fuel costs.

Table 16 Operating Costs per Tractor and Per Hour Worked

	V.O.			Diesel		
	Per Tractor	Per Hour	%	Per Tractor	Per Hour	%
	£ s d	s d		£ s d	s d	
Fuel	40 4 6	1 7	50.0	35 5 2	11	20.0
Lubricants	4 3 3	2	5.3	5 17 2	2	3.6
Total Fuel and Lubricants	44 7 9	1 9	55.3	41 2 4	1 1	23.6
Repairs	12 19 3	6	15.8	24 9 8	7	12.7
Servicing	1 15 7	1	2.6	3 1 7	1	1.8
Insurance and tax	3 15 1	2	5.3	5 4 5	2	3.7
Total Direct Operating Costs	62 17 8	2 6	79.0	73 18 0	1 11	41.8
Depreciation	15 11 11	8	21.0	102 12 9	2 8	58.2
TOTAL OPERATING COSTS	78 9 7	3 2	100.0	176 10 9	4 7	100.0
Av.age at start of year	5.4 years			2.5 years		
Av.written down value	£69			£456		
Av.no of hours worked	492			774		
Av.fuel consumption per hour	Petrol .09 gals. V.O. .85 gals.			Diesel .63 gals.		

In this analysis depreciation has been charged at the fixed rate of 22½% per annum on the written down value. This is not the most desirable method of calculating depreciation, but in the absence of detailed information regarding the length of the working life for the various models of tractors, it is the most satisfactory method which can be used here.

The charges made for depreciation in this calculation are based on the original capital cost of the tractor and on the age (i.e. period on the farm) - and these bear no direct relationship to the number of hours worked by individual tractors. This is a serious limitation of this method of calculation - in that it is the hours worked, rather than actual age which has the most influence on the physical depreciation of the tractor. However, as the 'hours worked' increases, the charge for depreciation becomes less in terms of costs per hour - as the fixed charge is spread over an increasing number of working hours.

It will be noticed from the foregoing table of data, that the charge for depreciation is higher in the case of diesel tractors than for V.O. models. This is due largely to two factors, firstly, that in comparison to V.O. tractors, diesel tractors tend to be newer - and secondly - that the initial capital cost is often higher in the case of diesel tractors than with V.O. models.

From an examination of Table 17 , the major differences in costs between the two groups of tractors are found to be fuel costs and the charges made for depreciation.

Fuel costs in the case of diesel tractors represent 20% of total costs as compared with 51% in the case of V.O. tractors. This is due to the fact that diesel fuel is cheaper than V.O. and also that diesel tractors, on average, have a lower rate of fuel consumption per hour worked.

No great divergence is noticeable in the comparison of the costs for repairs, servicing, insurance and tax between the two groups. In the depreciation charges, a wide difference is found between diesel and V.O. tractors - this difference has already been explained. It is sufficient here to notice that depreciation charges for diesel tractors are roughly three times greater than for V.O. tractors and have a very marked influence on the total operating costs per hour.

The average running cost for the 35 diesel tractors was 1s. 11d. per hour and as the distribution shows, there is an even distribution of variation from this mean.

Table 17 Range Distribution of Tractor Running Costs V.O. and Diesel

Range in Cost	V.O.	Diesel	All Tractors
		numbers	
Under 1/-	-	3	3
1/- to 1/6d.	2	8	10
1/7d. to 2/-	2	16	18
2/1d. to 2/6d.	6	3	9
2/7d. to 3/-	3	3	6
Over 3/-	4	2	6
Total	17	35	52

In the case of the 17 V.O. tractors in the sample, the average running cost was calculated to be 2s. 6d. per hour. The range of costs per hour was not so wide as in the case of diesel tractors - but here the variations within the range are not so evenly distributed around the mean. This may be due in part to the comparative sizes of the sample, 35 in the case of diesel tractors and 17 for V.O. tractors.

It can be seen from Table 18, that costs per hour, (i.e. total operating costs including depreciation) fall as the number of hours worked increased. While this may in part be due to a more efficient use of the tractor - such as longer running periods without stopping and starting - it is also clear that the fall in total operating costs must be mainly attributed to the fact that the depreciation charge is spread over a larger number of working hours.

If, however, we consider the total direct costs, i.e. the costs exclusive of depreciation but still including repairs, servicing,

tax and insurance and fuel, it will be seen that for V.O. tractors, the cost falls in the 500 - 1000 hour range and remains the same in the diesel group - rising again for both V.O. and diesel tractors in the 1000 and over range. This would seem to indicate economies of running costs within the 500 - 1000 range and further, that these economies are not extended into the 1000 hour and over range, where additional costs due to repairs and maintenance arise.

Table 18 Costs per Hour Related to Hours Worked

	Number of Hours Worked per Year					
	V.O.			Diesel		
	Under 500	500 - 1000	1000 & over	Under 500	500 - 1000	1000 & over
	s d	s d	s d	s d	s d	s d
Fuel & Lubricants	1 9	1 9½	1 9½	1 1½	1 0	1 2
Total Direct Costs	2 7½	2 5	2 7	1 10½	1 9	2 2
Depreciation	1 0¼	5½	2	5 0	2 7	2 2
Total Operating Costs	3 7¾	2 10½	2 9	6 10½	4 4	4 4
No. of tractors	10	66	1	5	22	8
Av. hours worked per year	345·6	626·2	1151·2	376·8	725·5	1154·0
Av. acreage per tractor	70	80	125	111	109	151

One further point emerges from Table 18 the relationship between the hours worked per tractor and the average acreage of tillage and grass per tractor.

For V.O. tractors that worked on average 500 hours or less per annum - the average acreage per tractor was 70 acres - similarly where V.O. tractors worked for between 1000 - 1500 hours annually - the average acreage per tractor was found to be 125 acres. This

shows that the acreage of a farm is one of the determinants of the amount of tractor work to be done during a year - and therefore of the tractor power needed on a farm.

Table 19 Comparison of Average Direct Running Costs for Diesel and V.O. According to Hours Worked

Total Hours Worked	V.O.	Diesel	Difference
	£ s d	£ s d	£ s d
0 - 499	59 19 7	46 17 6	13 2 1
500 - 999	114 12 6	80 4 1	34 8 5
1000 and over	193 15 0	162 10 0	31 5 0

It is clear from the above table of direct costs, i.e. exclusive of depreciation, that for each of the three ranges of hours worked, the difference in cost is in favour of diesel-fuelled tractors.

(x) Capital Outlay on Mechanisation

The table below is based on the original purchase price of the various implements or, where actual prices were unknown, an estimate has been used.

Table 20 Average Value of Machinery and Equipment

Class of Machinery	Average Value	
	Per 100 Acres Crops and Grass	Per Tractor in Use
	£	£
Cultivation and seeding	126.2	137.4
Fertiliser drills & distributors	51.2	55.7
Harvesting	327.2	355.9
General purpose	113.4	121.2
Total	618.0	670.2
Average Value of All Tractors	461.2	521.1

The tractor itself is but the nucleus of farm mechanisation and if its advantages are to be exploited fully other implements become necessary. Table 20 gives the value of such machinery found on the farm expressed as £'s value of machinery per 100 acres of crops and grass; and also in terms of £'s value per tractor in use.

The quantity and variety of farm machinery is continually increasing - much of the new machinery being the result of mechanical and technological advances and some of which represents improvements on more traditional methods.

New machinery and implements necessarily constitute a high capital expense to the farmer and in order that this investment is worthwhile, the new machinery must be fully and efficiently used. Expensive machines which are used in some cases for only a few days in the year, would appear to produce a low yield on invested capital.

(xi) Repairs and Tractor Age

A study was made among the 30 newly purchased diesel tractors in the sample to see if any correlation could be found between the age of a tractor and the cost of repairs. A similar study was made using hours worked instead of physical age as this was thought to be a more accurate measure of the extent to which a tractor had been used. This was confined to diesel tractors because there were not sufficient V.O. tractors for which all details of repairs were available.

No very definite results were obtained, though some interesting tendencies became evident.

1. For the first two years repair bills tend to be small and are made up of minor adjustments and general maintenance.

2. Between two and three years, tyres become a common source of expense in repairs. Remoulds were commonly used. Batteries too gave rise to some expense in this age group.

3. In the 3 - 4 year age group repairs to the fuel injection system were a common and costly item on many repair bills. Repairs to clutches also fell within this age group. Tyres too were common items.

4. In the 5 - 7 year age group, clutch and transmission faults were common and heavy expenditure was often incurred - tyres and batteries were still important.

III. A COMPARISON OF RESULTS, 1947 - 1959

(i) Comparison of Operating Costs

This comparison is drawn from earlier tractor investigations which were conducted along similar lines in 1947, 1951, 1955 and 1959.

The data in Table 21 has been broken down as far as possible. No comparative data for V.O. and diesel tractors are available for 1947 or 1951 when diesel tractors were less common. For comparative purposes V.O. and diesel tractors in 1955 and 1959 have been compounded under the general heading of 'all tractors'.

From this table it can clearly be seen that over the period of the comparison, costs of all tractors per hour have risen - though between 1955 and 1959 the cost per hour of diesel tractors appears to have risen more sharply than for V.O. tractors.

The charge for depreciation has risen for all tractors but this can be largely apportioned to the diesel tractors which tend to be newer and more expensive, the age difference showing clearly in the 'age of tractor'column, and the average purchasing price being shown similarly.

The hours worked appear to have fallen in 1959 but here it must be pointed out that this table is made up of comparisons of data drawn from different samples which invalidates to some extent any detailed comparison.

(ii) Changes in Cost Structure

The data in Table 22 show that the importance of fuel costs for V.O. tractors increased by 4.4% between 1955 and 1959, while that of the diesel models fell by nearly 2%.

The depreciation charges for 1947 and 1951 can probably be compared with the V.O. figures for 1955 and 1959 on the grounds that diesel tractors were a very insignificant part of the sample in the two earlier years. On the basis of such a comparison, depreciation charges for V.O. tractors have generally fallen which would link up with the greater age of V.O. tractors in later years.

For diesel tractors in 1955 and 1959 depreciation charges have risen, a factor which can be attributed to a higher proportion of new tractors in the sample.

Table 21 Comparison of Total Costs Per Hour in 1947, 1951, 1955 & 1959

	All Tractors				V.O. Tractors		Diesel Tractors	
	1947	1951	1955	1959	1955	1959	1955	1959
	s d	s d	s d	s d	s d	s d	s d	s d
Fuel	11¾	1 10	1 0	1 1½	1 5	1 7	7½	11
Lubricants	2¼	2	1¾	2	2	2	1½	2
Total Fuel and Lubricants	1 2	2 0	1 1¾	1 3½	1 7	1 9	9	1 1
Repairs	7	3¾	6	6½	7¼	6	5¾	7
Servicing	1	1	2	1	1¼	1	2½	1
Insurance and tax	¼	½	1	2	1¼	2	¾	2
Depreciation	9½	1 1	1 9½	1 10¼	8½	8	1 4½	2 8
Total Costs per Hour	2 7¾	3 6¼	3 8¼	3 11¼	3 1¼	3 2	2 10½	4 7
Average hours worked	815	813	1021	681	848	492	1187	774
Average prices of fuel & oil per gallon:	s d	s d	s d	s d				
Petrol	1 11	3 5	4 2	-				
V.O.	10½	1 4	1 5	1 10½				
Diesel	1 0	1 2	1 3½	1 4½				
Lubricating Oil	5 1	6 9	8 6	9 6				
Average age of tractor (years)	4·3	3·3	3·5	3·4	5·3	5·4	2·3	2·5
Average purchased price(£)	256·1	307·0	446·0	641·9	346·0	429·8	543·0	691·4

Table 22.

Changes in Cost Structure Per Hour
(Expressed as a Percentage of Total Costs)

	All Tractors				V.O. Tractors		Diesel Tractors	
	1947	1951	1955	1959	1955	1959	1955	1959
	%	%	%	%	%	%	%	%
Fuel	37·0	52·1	27·1	28·6	45·6	50·0	21·7	20·0
Lubricants	7·1	4·7	4·0	4·2	5·4	5·3	4·4	3·6
Total Fuel and Lubricants	44·1	56·8	31·1	32·8	51·0	55·3	26·1	23·6
Maintenance:								
Repairs	22·0	8·9	13·6	13·8	19·5	15·8	16·7	12·7
Servicing	3·1	2·4	4·5	2·1	3·4	2·6	7·2	1·8
Insurance and tax	·9	1·2	2·2	4·2	3·3	5·3	2·2	3·7
Depreciation	29·9	30·7	48·6	47·1	22·8	21·0	47·8	58·2
TOTAL	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

APPENDIX

Costing Method

1. Prices of Fuel, Oils and Grease

These were charged at the actual cost to the farmer. Where information was not available the following average prices were used:-

Grease	1s. 8d. per lb.
Oil	9s. 6d. per gallon

2. Labour

Manual labour for servicing and repairs on the farm was charged at 3s. 11d. per hour.

3. Depreciation

Charged at 22½% of the written down value.

4. Repairs, Overhauls and Additions

These included garage, farm repairs and spare parts. Also charges as current expenses were replacements of tyres, batteries and engine overhauls, rebores, etc.

Additions to tractors, e.g. cabs, lights, P.T.O. units, etc. were treated as items of capital expenditure and were depreciated accordingly.